

This section describes the approaches used to analyze the building data compiled for this study. It explains the collection of data to assess the on site current construction practices, the code compliance analysis approach, the method for calculating the natural air changes per hour and the process used to verify the data entry.

## **4.1 CURRENT CONSTRUCTION PRACTICE**

The analysis is based on site surveys of 158 homes for thermal shell characteristics and lighting, and 159 homes for appliances. Of these 159 homes, 139 received complete site visits and the auditors collected partial data on the remaining 20, on the understanding that the homes had received energy ratings through the Vermont Star Homes program, and the thermal shell characteristics could be obtained from the program data files.<sup>1</sup> The data entered into the VTCheck analysis were built up from the detailed data collected on site for each building component and piece of equipment.

We analyzed these data by calculating the mean, median values and confidence intervals where appropriate for the quantitative building characteristics. For categorical data, we calculated the percent of houses that fell into different categories. In some cases, we documented the distribution of the values observed in the on site surveys.

## **4.2 CODE COMPLIANCE**

There are three verification methods for RBES code compliance, i.e., prescriptive approach, the VTCheck software, and the performance standard based on the Home Energy Rating System (HERS). In general, the prescriptive path is the most restrictive standard. VTCheck allows a wider range of trade offs between equipment efficiency and thermal components, and is therefore easier to pass than the prescriptive standard. The Home Energy Rating is performance-based and takes into account numerous house characteristics, such a solar gain, that are not included in either the prescriptive packages or the VTCheck software. Homes that do not pass either the prescriptive or VTCheck methods may still pass by the performance standard; however, the results of the home energy rating must be documented as part of the compliance process.

For most homes in the study, compliance was determined by the VTCheck methodology. For the nineteen homes that received HERS ratings, the performance standard was applied based on the results of the energy rating. A review of the homes that failed to meet compliance by either of these two methods showed that these houses also failed the prescriptive path.

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<sup>1</sup> In one case, the home did not actually receive the energy rating and the auditor could not reschedule. Consequently, only partial information covering lighting and appliances is available for this home. In another home, the lighting had not been installed at the time of the site visit.

We determined basic code compliance by running a simulation of VTCcheck software for each building based on the observed building characteristics collected on site. Using the VTCheck methodology, we calculated the maximum thermal transmittance (UA) allowed by the code and the UA calculated for the building as built (“Your Home” UA). The compliance software adjusted the allowable UA based on the efficiency of the heating equipment, with more efficient heating systems allowing higher building UAs. If the calculated UA was equal to or less than the maximum allowable value, we recorded in the database that the building complied with the code. These data, in combination with the energy rating results obtained from the Vermont Star Homes participants, allowed us to determine the proportion of houses that met the code and to document the distribution of the house UAs relative to the required level.

### 4.3 BLOWER DOOR ANALYSIS

A blower door test was conducted as part of the site visit whenever possible. A single point pressurization and depressurization test was performed at 50Pa to determine CFM50. The average of these two values was used to determine the leakage area. This data point was then used to calculate the average natural air changes during the months of September through May. The methodology used is described in the 2001 ASHRAE fundamentals as the LBL model. It adjusts for building height, temperature difference and wind speed. An average temperature difference of 30° F and an average wind speed of 5 mph were used in the calculation. There are a total of 156 data points in the sample. Of these, 137 were collected on site using the methodology discussed above.

The blower door tests on the remaining 19 homes were done by Energy Rated Homes of Vermont in conjunction with ratings for the Vermont Star Homes program. For these homes, the natural air changes per hour were obtained from the program data and were based on a single depressurization test. The calculations were done according to the methodology used by the program field staff.

### 4.4 DATA VERIFICATION

All major data points were checked for valid entries and cross-referenced with other related data points. The data entry for thirty-two (20%) randomly selected surveys was checked against the hard copy, showing an error rate of less than 1%. A few basic data points were checked against the telephone survey responses to look for patterns of errors in data collection, but this process did not reveal any systematic problems.